ESTIMATING THE RELATIVE MASS OF THE ELECTRON

Equipment

Discharge tube (Fig.4)
Horseshoe magnet
High voltage DC supply
Phosphorescent screen; mixture calcium phosphate with 1% manganous phosphate
(See Handbook of Chemistry & Physics for detailed list of materials.)

Prepare two aluminum electrodes from foil or thin sheet and install electrodes and fluorescent screen in glass tube as shown in sketch. Some of the electrons and ions generated by the discharge between the foil electrodes will pass through the holes in the electrode as a thin beam and strike the fluorescent screen. The relative mass of electron to ion may be determined by comparing the observed deflection of the electron and ion beam with a magnet. Careful measurement of the deflection of hydrogen ion and electron beams has allowed the estimation of the mass of the electron. It is found to be 1/1838, as heavy as a hydrogen ion. At high speeds the value is considerably larger due to relativistic effects.

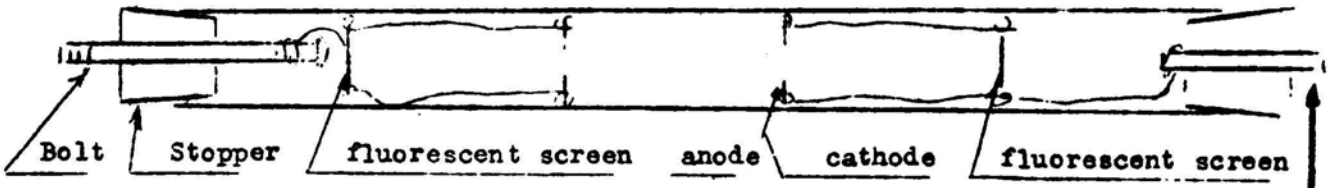
Since the deflection of the electron stream is much larger than the ion stream, it is desirable to determine the ion deflection at the lowest possible voltage and to determine the deflection of the electron at a high voltage.

$$\frac{\text{Mass electron}}{\text{Mass Hydrogen}} \qquad \frac{(\text{deflection electron})^2\ Vh}{(\text{deflection hydrogen})^2\ Ve}$$

By choosing voltages which give identical deflections and measuring them carefully, the ratio of M_e to M_H may be determined with considerable precision.

M_e Mass of electron
M_H Mass of hydrogen ion
Vh Measured voltage causing observed deflection of hydrogen ion
Ve " " " " " " electron

Deflection is the observed dislocation of beam/space between anode and screen. To minimize effects of inequality in magnetic field it is desirable to make both electrode-screen distances equal.



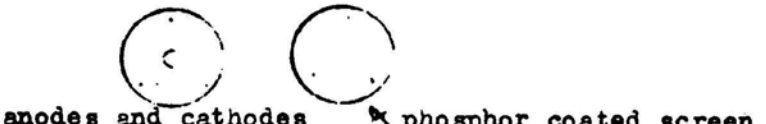
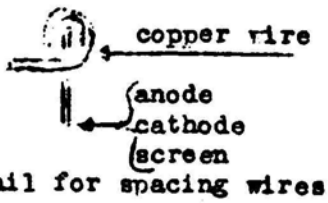


Fig. 4



Detail for spacing wires